STATUS REPORT OF PROJECTS FUNDED

BY NASA GRANT 298 THROUGH

THE UNIVERSITY OF KANSAS SPACE SCIENCE AND TECHNOLOGY COMMITTEE

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The University of Kansas
Lawrence, Kansas

Project 40A Critical Opalescence of Helium

Investigator: B. Chu

The primary purpose of this project is to set up a cryostat and other accessories for the small-angle scattering of X-rays of helium near its critical point.

The following items are being constructed:

1. a helium-nitrogen metal dewar has been built
2. a metal-glass high vacuum system is being assembled for the cryostat.
3. a bridge-type temperature sensor and controller (capable of maintaining temperature to $\pm$ 10 μ deg near the λ-point) will be completed in the near future.

The main problem is to achieve uniform temperature throughout the cavity where the X-ray traverses. The effect of heat dissipation due to X-ray radiation is being investigated at other more accessible temperatures.

Project 40 B — Synthesis of High Strain Energy Hydrocarbons

Investigator: A. W. Burgstahler

Synthesis of the sterically crowded hydrocarbon 2, 4, 6-trimethyl-t-butylbenzene has been achieved by forced coupling of mesitylmagnesium bromide in tetrahydrofuran with a large excess of t-butyl chloride. This represents the first successful entry into this long-sought highly strained structure, whose physical and chemical properties, along with those of its derivatives, can therefore now be investigated. As an alternative but less direct route to the 2, 6-dimethyl-t-butylbenzene system, the dehydration of 2, 6-dimethyl-1-t-butylcyclohexanol, with subsequent dehydrogenation, has also been explored.

Further efforts to synthesize appropriate intermediates for conversion into tetra-t-butylmethane and tri-t-butylacetic acid were unsuccessful. In one of the more promising of these attempts, the intended Michael addition of t-butylmagnesium chloride to methyl β,β-di-t-butylacrylate led to reduction of the double bond and formation of methyl β,β-di-t-butylpropionate.

In another connection, we have achieved the synthesis of tricyclic diterpene hydrocarbon fichtelite, a classical organic "mineral" found in certain decayed and partially fossilized conifers. This work also provides the first definitive demonstration of the stereochemistry of this interesting substance.

Project 40 C Energy Transfer in Atom Molecule Collisions

Investigator: F. S. Rowland

Professor Rowland is no longer a member of the University of Kansas faculty. The results which he achieved in NASA-sponsored investigation prior to his departure from us are summarized below.

The isotopic variations between CH_3F and CD_3F in recoil tritium reactions have been investigated for the 0_2-scavenged compounds, and for 0_2- and 1_2-scavenged mixtures with a large excess of He^4. The relative yields of $HT:CH_2TF:CH_3T$ from CH_3F are 185:100:33, and of $DT:CD_2TF:CD_3T$ from CD_3F 187:100:31, but the absolute yields of all products from CH_3F are higher than from CD_3F. The ratios of CH_2TF/CH_3T_4 and CD_2TF/CD_3T are only slightly affected by the presence of He^4 moderator, indicating that the reactions forming the compounds occur at about the same average kinetic energy for the tritium. The isotope effect in substitution for H or D favors H replacement by $1.27 \pm .03$ in a large excess of He^4. This fact implies that the primary source of the isotopic variation must lie in probability integral isotope effects, i.e. a larger probability for reaction per collision with CH_3F than for CD_3F and/or a larger range of tritium energy with which reaction is possible.

The tritium average energy losses in non-bonding collisions are gerater in CH_3F than in CD_3F. ($a_{CH_3F}/a_{CD_3F} = 1.15 \pm 0.05$)

Project 40 D Solvent Effects on Optical Spectra of Radical Ions

Investigator: J. Q. Chambers

The wave length shifts in the visible spectra of the anion radicals of nitrobenzene ($NB\cdot^-$) and nitromesitylene ($NM\cdot^-$) with hydroxylic solvents have been measured. The radical ions were generated electrolytically in dimethylformamide with varying amounts of water present. The radical ion solutions were pumped via an absolutely air-free system to a Cary spectrophotometer.

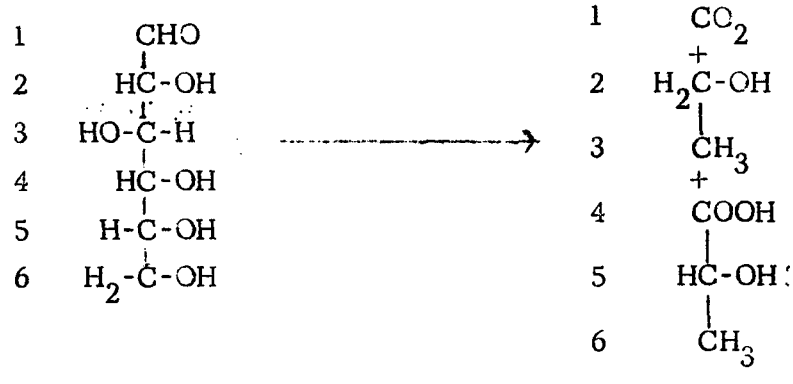
The "blue shift" (to shorter wave lengths) with increasing concentration of water is consistent with hydrogen bonding of the $NB\cdot^-$ with water. A very recent interpretation of the $NB\cdot^-$ optical spectrum (Nagakura, Bull. Chem. Soc. Japan, 1964) shows that the long wave length transition involves excitation of an electron from the nitro group to the ring. This is an excellent correlation with our observed blue shift. A similar correlation for $NM\cdot^-$ has not been achieved as yet.

A series of substituted nitro anion radicals is now under investigation. Modified Hückel molecular orbital calculations have been run for these, and the shifts in the optical spectra are being studied for better correlations.

Project 40 F Regulation of Metabolic Pathways in Chlorelia

Investigator: P. A. Kitos

A strain of green algae, Chlorella pyrenoidosa, was illuminated with intense white light in a lollipop-shaped glass vessel. A solution of glucose labeled with carbon-14 in position -1 was added to the culture. At brief intervals, samples of the culture were removed and the cells were killed instantly by boiling. The cells were then washed and extracted to remove the lipids and low molecular weight substances. They were then extracted with hot trichloroacetic acid to remove the storage polysaccharide, starch. The starch was hydrolyzed to glucose which in turn was purified by chromatographic methods. The glucose was then fermented by the microorganism, Leuconostoc mesenteroides, a process which leads to the formation of carbon dioxide, ethyl alcohol and lactic acid in the following way:



The products have been isolated and the specific radioactivity of each carbon atom derived from the sugar is now being determined. This involves chemical degradation of the lactic acid and ethyl alcohol. The results of these analyses should be available soon. They will be used to determine the amount of the ingested sugar that was converted directly to starch, compared to that which was catabolized to other products prior to reassimilation into starch.

Project 40G Elucidation of Cell Growth Stimulating Properties of Erythropoietin

Investigator: F. E. Leaders

The original proposal was divided into four sections. Progress will be discussed by sections.

1. Cell culture techniques: completed and reported on April 10, 1964.
2. Chick Chorio-allantoic membrance: completed and reported on April 10, 1964.
3. Antigenicity Studies:

Sheep ESF obtained from Armour and Co. (National Heart Institute, Hematology Study Section) and rabbit ESF prepared in our laboratory were studied. A modification of the Gel-diffusion method described by Robbins, et al. was used. There was no evidence that sheep and rabbit ESF are antigenically related. The control antigens and rabbit ESF all reacted strongly with anti-rabbit ESF guinea pig serum but not at all with anti-sheep ESF rabbit or guinea pig serum. It was possible to distinguish differences in number and position of lines formed by each system. Sheep ESF did not react with anti-rabbit ESF guinea pig serum. There was no reaction between preimmune serum and the antigens tested. Studies are in progress to test several human blood components in this system.

4. Effects on Leukemia:

The effect of ESF on induction and progress of leukemia in axenic, clean (ex-axenic) and conventional mice is being tested. The effects of a large single dose of ESF are under study. This is a long-term study (months) and no definite differences have been established at this time.

Project 40 H A Photographic Study of the Dynamics and Damage Capabilities of Bubbles Collapsing Near Solid Boundaries

Investigator: N. D. Shutler

The effect of proximal rigid boundaries on the motion and damage capabilities of spark bubbles was investigated by means of a qualitative photographic study. An axially symmetric bubble collapsing non-hemispherically against a solid boundary can form a liquid jet which impinges against the boundary, but the jet can do little or no damage. Observations of the toroidal minimum volume and associated boundary damage (circular dents on indium) indicated a pressure pulse damage mechanism. The non-hemispherical collapse of the original bubble, however, often caused less damage than the rebound bubbles. Larger, more energetic rebound bubbles commonly resulted from asymmetrically collapsing bubbles, formed when one places a second rigid boundary perpendicular to the first but not touching the bubble.

Project 40 I Atmospheric Turbulence

Investigator: F. C. Bates

Professor Bates is no longer a member of the University of Kansas faculty. The results which he achieved in NASA-sponsored investigation prior to his departure from us are summarized below:

Support was provided for a broad study of the state of knowledge of atmospheric turbulence significant to aerospace operations and the needs for knowledge in aerospace technology relative to the various phenomena classes as turbulence.

The findings of this study were:

1) The relatively-unappreciated diffluence of meanings of "turbulence" in fluid mechanics and aerospace technology has reduced the extent and effectiveness of contributions from the theoretical field of fluid mechanics toward the solution of problems in operational aero-astronautics.

2) Some of those problems are:

   a) Failure of structures in turbulence as aircraft are required to traverse new environments.
   b) Extreme demands which are placed upon control-and-guidance systems as missiles and spacecraft traverse intense fields of turbulence.
   c) The formulation of aerodynamic forces imposed in turbulence (Q(t)) in the analytical treatment of vibrations. It appears that the simple assumptions made for this function are woefully inadequate, and that modes of vibration of rather exotic nature can be generated.
   d) The anticipation of fatigue life and mode of failure of a given craft or component. Experiments such as the full-scale B-52 test postulate a prior knowledge of Q(t). This postulate is untenable upon the present state of knowledge.

3) Theoretical fluid mechanics has produced no adequate and sophisticated solution for turbulence.

4) A comprehensive program of observation and subsequent climatological treatment of turbulence has never been undertaken. Such a program should begin at the earliest possible date.

5) After introducing the available information about turbulence -- that obtained from restricted and ad hoc programs -- into the design and prescribed operation of aerospace vehicles, further safeguards are required to insure that the craft will not traverse fields of turbulence not considered in design, or that rough-air maneuvering of an effective nature will be undertaken upon encountering such turbulence.

6) Several studies are under way toward the needs cited above. Several uses of radar have been proposed and are under study (doppler and other detection of turbulent eddies), as are techniques involving the transmission of light. A study of low-level turbulence is being conducted by MASD, Boeing, having as one objective the development of a strain-gage sensor for turbulence. NASA and the Air Force have several programs for the observation and study of turbulence in various atmospheric regions. Various universities and research centers are studying restricted theoretical aspects of turbulence.

Project 40 J Thermal Stresses

Investigator: M. A. Mahayni

Professor Mahayni is no longer a member of the University of Kansas faculty. The results which he achieved in NASA-sponsored investigation prior to his departure from us are summarized below.

A continuation of the study of the effects of non-uniform temperature distributions produced by aerodynamic heating on the stability of cylindrical and conical shells is being conducted. The study includes:

1) the development of the general equations for large deflections of cylindrical and conical shells,

2) the solution of the resulting equations for axially symmetrical temperature distribution, and

3) the use of the 1620 computer to obtain numerical results for both cylindrical and conical shells.

An independent proposal entitled "Thermal Buckling of Shallow Shells" was submitted to NASA for support to continue and expand this study.

Project 40 K Minority Carrier Transit Time Distribution

Investigator: N. S. Nahman

A study of semiconductor diodes at 77^{o} K shows that the static diode characteristic vs. temperature can be predicted and that the knee and the slope of the I-V curve become sharper and greater, respectively, as temperature is decreased. Also, the knee voltage approaches the energy-gap voltage with decreasing temperature. The reverse recovery time decreases for decreasing temperature where the degree of the recovery time reduction is greater at high current densities.

Project 40 L Electron Microscope Study of Mica

Investigator: M. P. Bauleke

Transmission electron microscopy methods were used to study the development of lenticular defects in muscovite mica. Defects were classified according to size and diffraction characteristics. The most probable source of gases for the bubble formation was the gas entrapped between the mica layers. Defects concentrated in dislocation regions and were quite effective as dislocation decorators.

Project 40 M Electronic Specific Heat

Investigator: J. Pelleg

This project, under the direction of Dr. J. Pelleg, is investigating the specific lattice and electronic heat of some metals (Cs, Rb). The study should contribute:

1) specific heat data over a wide temperature range above liquid helium temperature
2) electronic specific heat
3) Debye temperatures
4) Indirectly, the study will provide other thermodynamic data.

A cryostat with a regulated vacuum system and instrumented-resistance thermometry is being assembled, together with associated equipment. Small quantities of high purity Rb and Cs metals have been obtained.

The calibration of resistance elements against known vapor pressures and the actual collection of data are still being delayed until critical equipment, which has been ordered, arrives.

Project 40N Scattering of Waves from a Rough Surface

Investigator: A. K. Fung

Kirchhoff - Huygens' principle, together with the physical optics method, is found to predict depolarization of circularly polarized waves. This prediction agrees with the results of lunar experiments. Significant backscatter re-radiation originates from both regions on the surface which have normal orientation to the incident wave and regions which do not; the relative importance of each depends on the angle of incidence. Edge effects resulting from the finiteness of the illuminated area are not always negligible where the physical optics method is valid.

Project 40 P Immunological Analyses of Biological Systems

Investigator: C. A. Leone

The feasibility of identifying biological unknowns using pooled, broad-spectrum antisera was established. Serological technics as a diagnostic method are restricted to identifications of stable saline-soluble proteins. Individual antisera possess restricted ranges of cross-reactions. Among the vertebrates, for example, interclass reactions are beyond the range of most antisera. A pool of antisera against representatives from each class provided a reagent that would identify organisms in the Subphylum Vertebrata and no others. In the Phylum Orthoptera the ranges of individual antisera are even more restricted, a limitation imposed by greater biological differences among organisms included within a given taxonomic category. For example, within the Crustacea, cross-reactions were obtainable only within the Order Decapoda. Interordinal reactions within the class were impossible. A pool of anti-Crustacea sera, however, positively identified any crustacean tested, of those within our present collection. The limitations of the Class Insecta restrict it even more than those of the Class Crustacea. Several pools of overlapping mixtures of antisera were necessary to positively identify insects representing only a small number of the total of kinds of insects available.

The specificity of the serological reactions provides positive and precise identifications that are not within the capabilities of other means of biological assay. The test system can be completely automated and integrated into existing telemetry systems. A pilot-type communication system already in operation at the School of Aerospace Medicine is available to test the long-distance transmission of data on biological unknowns. Our next program will be to develop an adequate communications system here at the University of Kansas.

Project 40 - Q Genetic and Environmental Factors Involved in Streptococcal Disease

Investigator: C. P. Sword

Methods for cell lysis and DNA extraction have been developed with Lancefield group H strains as a model system. Maximal transformation rates occur at 40° C. A transforming medium free of blood products has been devised to study the exchange of genetic information in a defined system. Transformation rates up to 5% are obtained in this medium. Preliminary experiments with pathogenic Lancefield group A strains, using a streptomycin resistance marker, have been negative. DNAse was eliminated as a barrier to transformation by blocking protein synthesis during experiments with chloramphenicol. Currently alterations in the cell wall of group A strains are being induced with penicillin and other agents in an attempt to increase DNA incorporation into potential recipients.

Project 40T Telemetering Pulse Rates

Investigator: E. R. Elbel

Attempts are being made to telemeter pulse rates while subjects are involved in vigorous physical activity.

A three-lead two-channel transmitter 4" x 3" x 1 1/2" is being used. Impulses are picked up on a conventional FM radio and are fed through a monitor to a recorder. Experimentation has shown that the miniature EKG-type electrode is the most satisfactory. The best places to attach electrodes are the flat surfaces on the chest at the upper and lower ends of the sternum. The reference electrode is placed at the right side of the subject's back at about the fourth rib, although exact location of this electrode is not important.

Recordings taken at relatively close range have been very satisfactory. However, considerable difficulty has been encountered in long-range transmission due to the interference of various FM stations in the area, two of which are in the immediate vicinity. It has been observed that during certain hours of the day relatively large areas of the dial are occupied by these stations. When this is the case, our recordings are entirely inadequate. Attempts are being made to correct the problem. It may be necessary to use the "citizen's band."

Project 40U Acid-Base Catalysis of Silane Decompositions

Investigator: R. L. Schowen

The acid-base catalysis of silcon-hydrogen bond cleavage and structural effects on the catalytic sensitivities are being studied. The specific rate of the methoxide-catalyzed decomposition of triphenylsilane in methanol at 25°, measured by a gas-evolution method, is given by

$$k = (0.002 + (2 \times 10^{-5}) \quad NaOCH_3 \quad) \text{ sec.}^{-1}$$

The uncatalyzed term may be spurious, and we are investigating its possible origin in salt effects. Silanes are oxidized by iodates, and triphenylsilane in 20-mg. quantities can be estimated to $\pm$ 10% using standard procedures for excess-iodate determination. Triphenylsilane in 20-mg. quantities may be determined to $\pm$ 3% by reaction with iodine, followed by standard iodimetry (improved Westermark method). Carboxylate catalysis of alkylsilane and arylsilane decomposition is being studied using these techniques.

Project 40V The Characteristics of the Human Operator in Certain Control Systems

Investigator: J. Akashi

The human operator's ability to control various systems in a compensatory manner is being investigated with emphasis on the measurement of his capacity in terms of given systems. Results so far indicate that human control capability can be measured rather satisfactorily by a set of parameters of the controlled system--namely, gain and time constant. In general, an increase in gain or shortening of time constant makes the system more difficult to control; quite expectedly, higher-order systems are also more difficult. In evaluating the operators' control capability, their control performance has been expressed in terms of a curve in a parameter plane, and the different training backgrounds of various operators have been reflected in definitely different curves on the plane.

Project 40 V. Experimental Study of the Effect of Plastic Deformation On the Yield Surface of Metals

Investigator: L. E. Linzell

The combined-stress plasticity testing machine (of the tension/compression and internal pressure type) and its allied equipment have been designed and constructed. Two test specimens (12" long and 5" diameter with 0.01 wall thickness) were machined. Preliminary experiments to determine the performance of the testing equipment and to familiarize the investigators with the equipment have been completed. During these experiments it was found that the test specimen was not long enough. An 18" long test specimen was machined. Tests proved it to be of sufficient length.

The literature search is substantially complete, and the collection of data from the testing equipment has begun.

Additional 18" test specimens are being machined and will be tested.

Project 40-Y Microwave Spectroscopic Studies at Elevated Temperatures

Investigator: M. D. Harmony

A microwave spectrometer to be used for the study of gases at elevated temperatures has been constructed. It has been tested and operated in the temperature range 25 to 250° C. The spectrometer is currently being used to study the spectrum of the urea molecole, $(NH_2)_2CO$. This compound must be heated to at least 100° C. to achieve a useable vapor concentration ($\geq 10^{-2}$ mm Hg). Some difficulty has been encountered due to sample decomposition, but a proper choice of the operating temperature alleviates the problem. A search for urea absorption lines in the 8 to 25 kmc frequency region is now being made.

Project 40 2 — Effect of nonionizing radiation on interferon Production

Investigator: R. H. Bussell

Cells grown in culture have been given small doses of ultraviolet irradiation, and the effect of the irradiation on the cells' ability to support virus multiplication and produce interferon has been studied. Interferon is a protein produced by virus-infected cells which is capable of limiting virus multiplication. It is believed that interferon constitutes an important host defense mechanism.

We have studied the effect of exposing continuous and primary cell cultures of human, monkey and chick embryo origin to small doses of ultraviolet irradiation. Cells exposed to 100-200 ergs retain their viability, as determined by the eosin exclusion test and replating techniques. Higher doses result in cell death. Exposure of cells to the above maximum tolerated doses resulted in a stimulation of metabolic activity over that observed with non-irradiated control cells.

Project 40 - AA Associative Memory Simulation

Investigator: J. N. Warfield

This project demonstrated the realization of associative memory techniques on conventional digital computers, using only a single search cycle which allows for computing an address and a binary comparison. An information-retrieval language was developed which adapts readily to syntax-oriented translation using associative memory techniques. The work shows that it is possible to have the speed advantage of the associative memory concept over sequential searching, without awaiting major technical break-throughs in special-purpose equipment design.

Project 40-BB Cooperative Studies with Erythropoietin (ESF)

Investigator: M. P. Mohn

A colony of large laboratory rabbits has been procured and a regular schedule of bleeding has been maintained to provide serum for the preparation of ESF, using Borsook's method. Approximately 220 m. of ESF, an amount equivalent to about 6600 Cobalt units of ESF, has been purified and bioassayed for potency. Two more batches of ESF, for a total of 550 ml, are ready to be bioassayed.

Isolation, purification and identification of ESF from fractionated human blood: The necessary laboratory equipment has been obtained, using funds from other sources, and the four plasma fractions cited in the last report have been extracted for ESF. Biological assays on this material are in progress to determine which fraction(s) contains the greatest amount of active hormone.

Studies of ESF in relation to the integument and other epithelial tissues: Several groups of young underfed rats were utilized for studies of nail growth (mm/day) and hair growth (both spontaneous replacement and growth induced by plucking). No enhancement was observed in ESF- or Cobalt-treated animals; however, these results may represent decreased responsiveness to ESF due to malnutrition. Further experiments are in progress to examine the effects of ESF and Cobalt in old rats, cortisone-treated animals, and propylthiouracil-treated rats. If ESF is capable of stimulating nail or hair growth, it should become evident in one or more of the conditions just mentioned.

Experiments designed to test the effects of ESF on mitotic activity in the integument and other tissues have been performed, but the mitotic counts have not been completed to date.

Preliminary studies of wound healing in underfed rats suggest enhanced healing with ESF treatment, and additional studies have been scheduled. Also, several transplantation experiments are contemplated.

A study of the effect of ESF on antibody formation and morphology of immunologically competent cells: Salmonella typhosa H antigen was injected into rats, the animals sacrificed 6 days later, and tissues removed for light and electron microscopic observations. Both microscopic methods indicate an increase in the number of plasma cells. More electron micrographs are needed, however, before any cellular changes within plasma cells and related cell types can be evaluated. After completion of the control studies, animals will be injected with ESF (with or without the antigen) and the tissues and cells will be removed for comparison with the appropriate stage of normal immunological response.

Project 40 - CC Blackout Phenomenon in UHF Pencil Triode Tubes

Investigator: N. S. Nahman

When an electron tube operating in the common cathode mode receives a pulse of energy on the grid sufficient to cause grid current to flow, the tube may suffer blackout. Blackout is characterized by failure of the plate current to return to its previous d.c. level after the grid pulse ceases. This effect has been observed to a widely varying degree in 170 UHF pencil triodes. A smaller quantity of these tubes have been operated continuously for several months and the blackout effect has varied with time. Blackout is probably caused by a contamination of the grid structure. A magnetically-coupled drill and associated vacuum equipment is being prepared to open a tube under a high vacuum while it is operating to determine if gassing accompanies the blackout effect.

Project 40 DD — Collapse Loads of Laterally Loaded Thin Rectangular Plates

Investigator: N. Willems

The general procedure followed in this project is to carry out tests on rectangular plates so as to permit the determination of collapse patterns and at the same time measure strains. From these tests the validity of presently assumed deformation patterns is to be analyzed. New kinematically-admissible fields will be constructed where necessary. From these tests it will also be obvious what the directions of the principal stresses are and whether certain yield conditions should be used in preference to others.

During the two summer months (June and July 1964) most of the research was on different failure theories and on setting up satisfactory testing equipment. Trial tests were run which resulted in certain changes of the equipment, as one of the main technical difficulties appeared to be to ensure the proper boundary conditions physically.

Project 40 EE Effects of Various Adjuvants upon Antibody Synthesis

Investigator: M. J. Freeman

The purpose of this investigation is to elucidate the effects of immunization with various types of antigens, either with or without adjuvants, upon the antibody response of the rabbit. Groups of rabbits have been immunized with bovine serum albumin alone (administered by several routes) and with the adjuvants sodium alginate and acrylic resin particles. Several immunochemical techniques including radioimmunoelectrophoresis, hemagglutination, precipitation and immunodiffusion will be used with physicochemical methods for the qualitative and quantitative characterization of the antibody produced.

Project 60A and 40R Transformation of Inorganic Sulfur Compounds

Investigator: J. M. Akagi

This investigation concerns the reduction of sulfite and thiosulfate to hydrogen sulfide by cell-free extracts of the thermophilic sulfate-reducing bacterium, Clostridium nigrificans. The enzyme systems required for the formation of hydrogen sulfide from the above compounds are (1) the pyruvic phosphoroclastic reaction which serves as the electron donating system, (2) an electron transport system and, (3) the sulfite-reductase system.

Studies on the phosphoroclastic system of C. nigrificans were completed and the results appeared in the Journal of Bacteriology (vol. 88, pp 813-814, 1964). Present experiments deal with the isolation and characterization of an electron transport system participating in sulfite reduction. Preliminary results indicate that a protein fraction, which adsorbs to a diethylaminoethyl (DEAE) cellulose column, functions as an electron carrier. We are attempting to correlate this activity with the reductive process occurring in C. nigrificans.

Project 60 B Leidenfrost Phenomenon

Investigator: R. B. Mesler

When a drop of water is placed on a hot enough surface the drop will dance around and take several seconds to evaporate. During this time it is commonly believed to be insulated from the surface by a film of vapor.

We suspect that the drop, instead of being insulated by a film of vapor, may be bouncing on the surface. We hope to measure the surface temperature beneath the drop with a special fast-response thermocouple. If the drop is bouncing, the surface temperature should drop to the saturation temperature with each bounce.

To date we have found that the drop definitely bounces when it first hits the surface. This is shown not only by the surface temperature, but also by high speed motion pictures. Thus far our apparatus has been capable of following the drop through only one or two bounces. We are presently redesigning the apparatus to permit study of drop behavior after the drop has been on the surface some time.

Project 60 C Dispersion Strengthening of Metals

Investigator: M. P. Bauleke

Nonmetallic additions to a metal can improve certain high temperature properties, such as strength and creep. Most investigations have concentrated on the use of refractory nonmetallics, but a less refractory material, if it melts at a temperature well above that of the metal, should produce suitable dispersion strengthening. Zinc oxide, calcium fluoride and calcium carbonate have been selected for dispersion strengthening studies in aluminum. Zinc oxide should function as interwoven fibers. Calcium fluoride has an exact thermal expansion match, but has surface characteristics which may make bonding difficult. Calcium carbonate can undergo thermal decomposition, but at temperatures above processing or service for aluminum. If calcuim carbonate proves practical, there are several other carbonates or sulfates that might also be serviceable.

Material will be fabricated by hot pressing in graphite molds. Evaluation will be done by measuring strength at various temperatures. We also hope to investigate the mechanism of metal-nonmetallic bonding for each material.

Project 60D — Studies on the Antigenic Properties and Structure of Isozymes of Schistosoma Japonicum and Trichinella Spiralis.

Investigator: D. G. Dusanic

Equipment has been purchased for this project, although all has not yet arrived. Special pieces of apparatus are being constructed by the investigator (i.e. special cells for polyacrylamide gel electrophoresis). Currently, animals are being infected with Trichinella spiralis. Antisera and parasites will be collected from these animals for use in the experiments. Permits for the shipment of Oncomelania have been obtained from the Department of Health, Education, and Welfare. These have been sent to Dr. Mariano J. Yagore, Jr., Department of Parasitology, Institute of Hygiene, University of the Philippines, who will send infected, field-collected snails for use in these studies. Preliminary studies should be initiated by December 1, 1964 on the serology, isozymes of these parasites and the hosts, and on the effects of antisera on these isozymes.

Project 60 E Mechanism of Silicone Decomposition

Investigator: R. L. Schowen

Mr. Kenyon Latham, Jr. is studying the cleavage of triaryl-aryloxysilanes in methanol, using the change in ultraviolet absorption of the system on reaction to determine the kinetic laws in buffers at 25°. He finds, in agreement with previous work, that both acids and bases accelerate the reaction. Further, he has demonstrated that the high-pH reaction is specific-base-catalyzed; this implies that the bond to the base in the activated complex is very strong. Initial results indicate general-acid catalysis at low pH. Continuation of this work should reveal the degree to which the acid catalyst is bound, the amount of charge which has accumulated on the silicon atom, and the degree to which the silicon-oxygen bond has undergone fission in the activated complex.

Project 60 F Iron-Copper Powder Magnets

Investigator: N. I. Ananthanarayanan

The magnetic characteristics of iron-copper compositions prepared from the metal powders are being examined in order to determine the suitability of such compositions for permanent magnets. Results of earlier work on a 50% iron-50% copper composition indicate that improved materials may be obtained with other iron-copper compositions utilizing finer powders and modified heat treatments.

Proposed studies include preparation, heat-treating and magnetic testing of iron-copper compositions (containing up to 25 per cent copper) in the form of powders and as fabricated into rods, wires, and tapes.

The initial phase of the project, now under way, consists in setting up the required test equipment.

Project 60 H Improved Multiple-Layer Insulation for Cryogen Storage

Investigator: G. W. Swift

The investigators are developing a technique for bonding fiber glass strands, in nets of given mesh size, directly to cryogen storage vessels. When such a net is bonded to the vessel, it will be covered with a layer of aluminum foil, another mesh will be bonded to the foil, and so on until a specified number of shields per inch have been fabricated. Several advantages are anticipated from this type of multiple-layer insulation. The bonded fiber glass net-aluminum foil matrix should have excellent compressive loading characteristics; its aluminum foil shields, unlike those in presently existing multiple-layer blankets, should not touch one another under compression loading. Similarly, acceleration loading should cause no thermal short-circuiting. Evacuation of the matrix should require less time than is needed for existing blankets: the regular pattern of the mesh will make it much more permeable to gas flow. Finally, since it will be bonded and since the layers will be of precise thickness, this matrix may well be machinable, so that mitered end sections may be fitted into place without causing thermal shorting. A number of small cryogenic storage vessels will be fabricated with various fiber materials, shield materials, net spacings, shield spacings, and so on. The vessels will be filled with a cryogen, and boil-off versus time will be measured. The data obtained will be reduced to apparent thermal conductivities by solving the steady-state conduction heat transport equation with the boundary conditions specified by vessel geometry and boil-off data.

Project 60 J Central Recording of Field Biological Data

Investigator: H. W. Shirer

This project is studying the engineering and biological problems associated with the use of remote, continuous measurement methods to minimize disturbing influences in ecological investigations. Conventional methods of investigation, such as direct human observation of field behavior, trapping for home-range analysis, and removal for laboratory physiological measurement, not only tend to produce meager data considering the effort expended, but generally cause large deviations from the natural state. This study will be carried out as a supplement to conventional methods by establishing a central facility at the University Natural History Reservation for continuous recording of data from a number of sensors placed in unique environmental sites and implanted in selected members of its population.

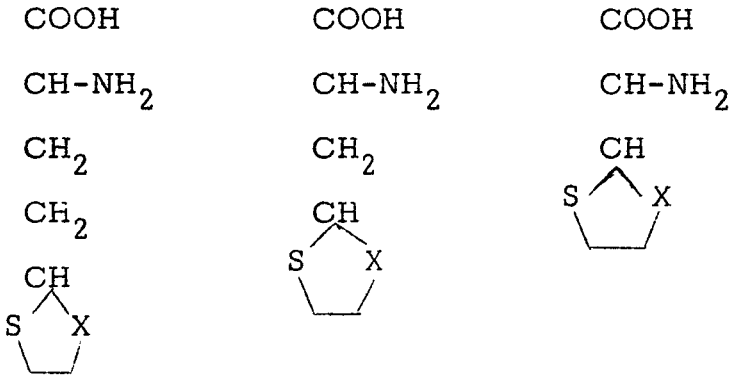
Of primary concern are problems of (1) design of sensing methods that minimize either the alteration of the microenvironment or the physiological burden imposed on the organism, and (2) transmission methods that combine prolonged recording reliability with minimal restraint of the subjects. These two problem areas will be explored through the use of specific ecological investigations. Two such examples are: the behavior of hibernating turtles in relation to their surface, deep body, and immediate environment temperatures, studied with implanted thermistors connected by long wire lines to the recording center; and the pattern of home-range wandering of selected species, determined by radiosonde telemetry from attached beacon transmitters.

Project 40E and 60K Dithiolanes as Radiation Protective Agents

Investigator: M. P. Mertes

Many compounds have been found to be effective in the protection of animals from lethal doses of high-energy radiation. All of the internal protective agents presently under investigation have a short duration of action and high toxicity. In an effort to improve the action and increase the effectiveness, a series of new heterocyclic compounds related in part to known protective agents is being synthesized.

The dithiolane and thioxalane analogs of amino acids have been selected as the models for study. The synthesis of compounds I, II, and III is now in progress. Both the dithiolanes (X=S) and the thioxalanes (X=0) will be synthesized.



I II III

a) X=S a) X=S a) X=S

b) X=0 b) X=0 b) X=0

The compounds will be tested for the protection afforded aqueous solutions of enzymes and laboratory animals exposed to high doses of X-radiation.

Project 60 - L Susceptibility to Sleep Induction:
Psychological Hibernation Studies I

Investigator: M. E. Wright

Accessibility of and resistance to sleep may significantly influence individual performance under sustained isolation conditions. The initial phase of a study of waking and sleeping under such conditions has begun, and is concerned with developing psychodiagnostic sleep behavior instruments, psychophysiological differentiality indices associated with waking, resting and sleeping states, and techniques of facilitating and disrupting sleep induction. The project was begun in September, 1964; a sleep-habit inventory will be tested by late November, 1964.